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**ENVIRONMENTAL IMPACT ASSESSMENT  
FOR AN EXPLORATORY WELL AND ACCESS ROAD  
AT KAIPAPA'U, OAHU**

**Tax Map Key: 5-4-4:4**

**Proposing Agency**

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**January 31, 1989**

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## **CHAPTER 1**

### **INTRODUCTION AND SUMMARY**

#### **1.1 APPLICANT/PROPOSING AGENCY**

Board of Water Supply, City and County of Honolulu

#### **1.2 APPROVING AGENCY**

Office of the Governor, State of Hawaii

#### **1.3 AGENCIES CONSULTED IN MAKING THE ASSESSMENT**

Office of Environmental Quality Control

#### **1.4 PROJECT OBJECTIVES AND BACKGROUND**

In the fiscal year ending June 30, 1987, the Honolulu Board of Water Supply (BWS) system served a population of over 800,000. Average daily water demand on the island during this period was 141 million gallons (mg). According to BWS projections, average daily water demand in the year 2000 will be 181 mg, an increase of 28 percent.

To meet growing demand, BWS has initiated a comprehensive groundwater development program. It proposes to drill an exploratory well on the north slope of Kaipapa'u Gulch, mauka of Hau'ula town, to determine the yield and quality of potable water at this location.

#### **1.5 PROJECT AND SITE DESCRIPTION**

The proposed exploratory well will be located on a knoll overlooking Kaipapa'u Gulch, about three-quarters of a mile southwest (mauka) of Kamehameha Highway. The site is at an elevation of about 145 feet on the north slope of Kaipapa'u Gulch. It is within the Conservation District, Resource (R) subzone, on land owned by Plumbers and Fitters Local 675.

A temporary construction road will be required to provide access to the well site; the tentative road alignment is illustrated in Figure 1. The project will involve drilling a hole about 16 inches in diameter to a depth of about 400 feet. Once the drilling is completed, a 12-inch diameter steel casing will be grouted into place and a pump installed. A series of aquifer tests will be conducted to determine the sustained well capacity and water quality. Upon completion of the test pumping, the well driller will remove the pump, cap the well, and clean the area. The estimated project duration is six to seven months.

#### **1.6 POTENTIAL IMPACTS, MITIGATION MEASURES, AND ALTERNATIVES**

No significant adverse impacts are expected during the drilling and pumpage test, and no permanent impacts are anticipated. A temporary reduction of stream flow during the five-day pumpage test is possible. Short-term impacts during construction of the access road include noise from equipment and erosion. Measures will be carried out to minimize or alleviate the impacts.

Three alternatives to the project have been considered—no action, delayed project, and alternate sites—but none of these would enable the Board of Water Supply to achieve its stated objectives.

**1.7 GOVERNMENTAL PERMITS AND APPROVALS**

The following permits/approvals will be required:

Conservation District Use Permit  
Well Drilling Permit

Department of Land and Natural Resources  
Department of Land and Natural Resources

## **CHAPTER 2**

### **PROJECT DESCRIPTION**

#### **2.1 PROJECT SITE**

##### **2.1.1 Location and Description**

The site for the proposed exploratory well is on the north slope of Kaipapa'u Gulch, about three-quarters of a mile inland from Kamehameha Highway in Hau'ula town. The well site will cover an area of about 30,000 square feet (200' X 150') on the steep side of a grassy knoll overlooking the gulch. It is at an elevation of approximately 145 feet above sea level, and the slope is in the range of 30 percent. (See Figure 1, Location Map, and Figure 2, Photos of Well Site and Access Road Corridor.)

The proposed access road will generally follow an existing trail that starts at the end of Kawaipuna Street, follows a route on the north side of Kaipapa'u Gulch, and ends about two-thirds of the way to the well site. At this point, the access road will continue along the slope up to the site.

##### **2.1.2 Land Ownership**

The well site is located on a 159-acre parcel owned by the Plumbers and Fitters Local 675 of the United Association Trust (Tax Map Key 5-4-4:4). The road will cross three parcels. It will start off for a short distance on land owned by Green Growers, Inc. (TMK 5-4-4:24), and then proceed on property owned by Elaine L. Chang, Trustee of the Elaine L. Chang Trust (TMK 5-4-4:3). The remainder of the road, starting at about the half-way point, will continue on Local 675 land.

##### **2.1.3 Land Use Designations and Controls**

The proposed well site is within the State Conservation Land Use District, Resource (R) subzone. A short section of the access road alignment starting at the end of Kawaipuna Street is in the Urban Land Use District; the rest is in Conservation.

On the City and County of Honolulu Development Plan Land Use Map, the proposed site is within an area designated "Preservation." The project area is zoned P-1, Preservation.

#### **2.2 PROPOSED FACILITIES AND ACTIVITIES**

The project will involve the following:

- Clearing and grading of a dirt access road, approximately 3,700 feet in length, that will follow the route of an existing hiking trail on the north slope of Kaipapa'u Gulch and then continues cross-country along the slope up to the well site. The road right-of-way will be 12 feet wide.
- Clearing and grading of the well site, which will cover a 30,000-square-foot area.
- Drilling and pumpage tests. A hole about 16 inches in diameter and approximately 400 deep will be drilled to reach fresh dike basal groundwater. (This is groundwater that floats on top of salt water and is partially prevented from moving seaward by relatively impermeable dikes in the basaltic lava flows of the Koolau Range.) Two possible drilling methods are available: cable tool drilling or rotary drilling. Given the expected depth of the well, the cable tool drilling method will probably be used. (Rotary drilling is generally more expensive and used

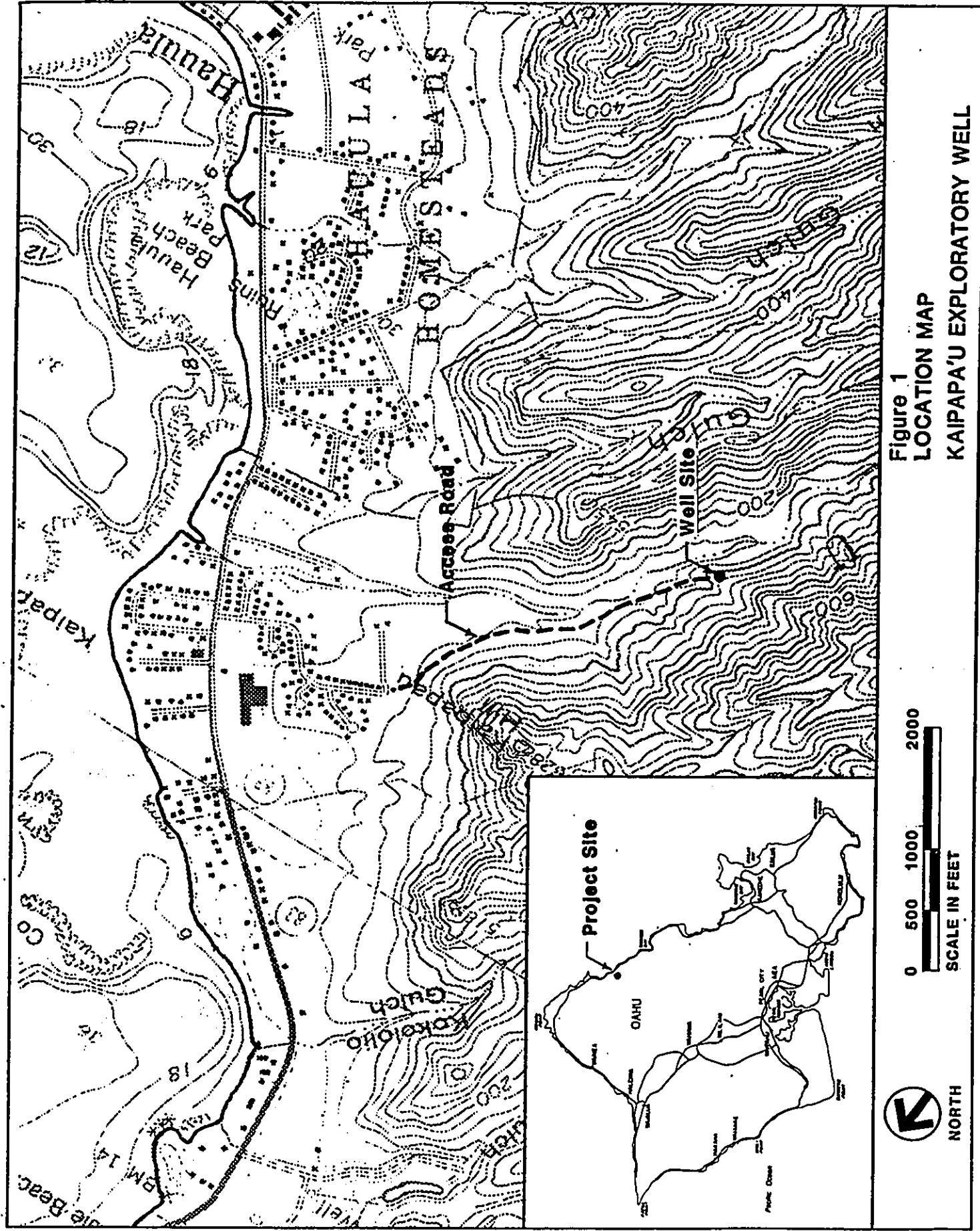
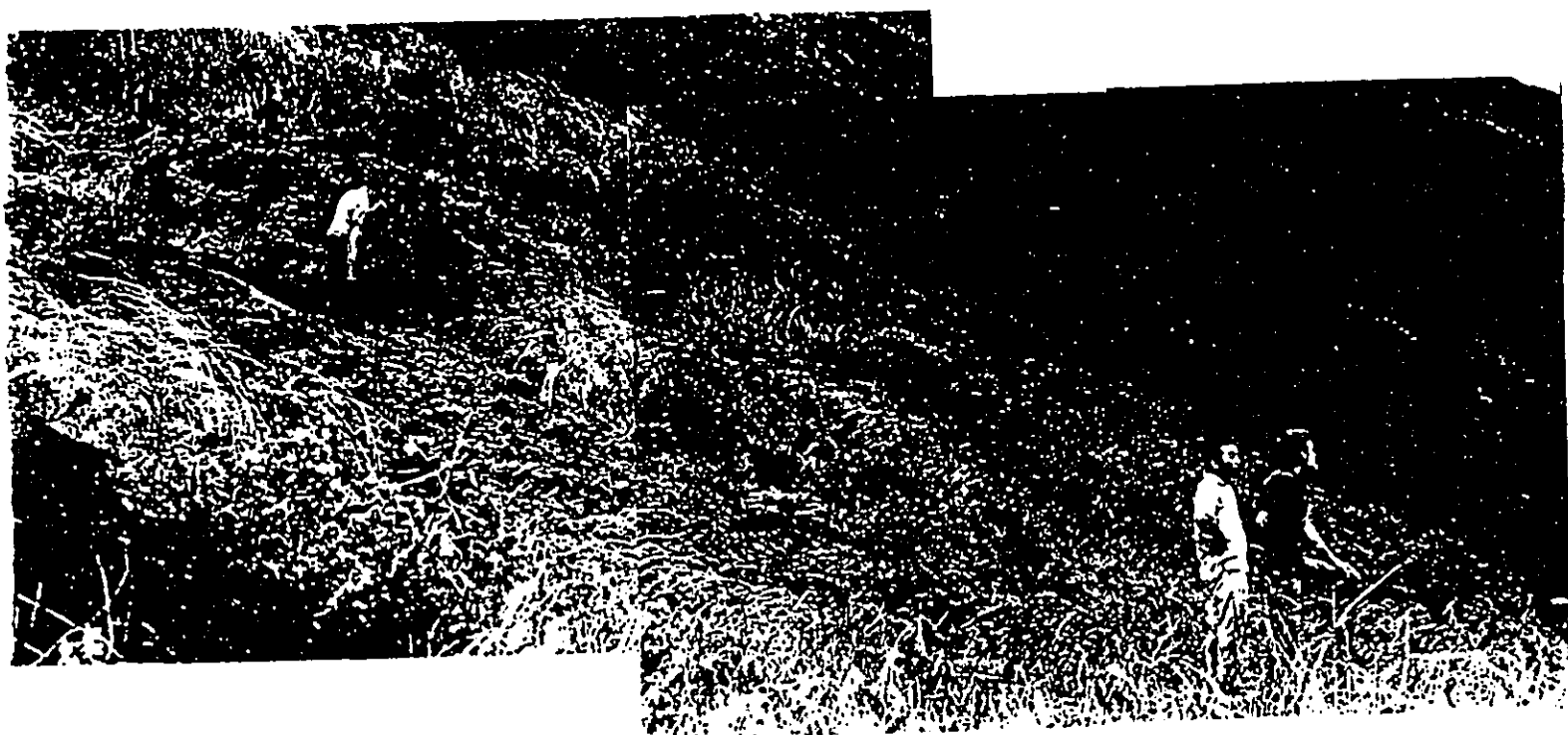


FIGURE 2. PHOTOS OF WELL SITE AND ACCESS ROAD CORRIDOR



for drilling to depths of more than 800-1,000 feet.) Drilling is expected to last about three to four months. Once it is completed, a 12-inch diameter steel casing will be grouted into place, a pump will be installed, and test pumping will commence to determine the extent and quality of the aquifer. Two pumpage tests will be conducted: a short-term yield drawdown test and a continuous test for five days. The well driller will then remove the pump, cap the well, and clean the area.

If the test results show that source development is feasible, the Board of Water Supply expects to convert the test hole into production facilities. It is estimated that the Kaipapa'u source will yield approximately 1.5 million gallons per day (mgd), but this can only be confirmed by test pumping. The test results will indicate the facilities needed for source development, including the well pump and required appurtenances. The well will be part of the proposed Hau'ula 180 system, including new reservoir and well facilities in Ma'akua, Hau'ula, Waialeale, Laie, and Malaekahana. BWS must obtain the necessary permits and approvals to carry out this final phase. Installation and operation of a production well is subject to the environmental review process stipulated in Chapter 343, Hawaii Revised Statutes, and Chapter 200 of the State Department of Health Regulations.

## **2.3 PROJECT SCHEDULE AND COST**

The project is expected to begin in mid-1989. Drilling contractors are usually allowed a year to complete an exploratory well. After clearing and grading of the access road and well site, estimated to take about a month, drilling will commence and be completed in about three to four months. One or two weeks will be required for installing the casing and another two weeks for installing the pump and running the pumpage tests. Demobilization will take approximately two weeks. Total project duration is estimated to be six or seven months.

The estimated cost is \$200,000 (approximately \$50,000 for the road and \$150,000 for the exploratory well). Funds are available in the BWS budget for the fiscal year ending June 30, 1989.

## **2.4 NEED FOR THE PROJECT**

The Board of Water Supply currently serves a population of more than 800,000; in the fiscal year ending June 30, 1987, island-wide average daily water demand was 141 mg. The BWS's Honolulu District, extending from Aliamanu to Hawaii Kai, is the most heavily populated and has the highest domestic water demand on the island. In the 1986-87 fiscal year, average daily water demand in Honolulu was 80.5 mg. About half of this amount (42.8 mgd) was produced from sources within the district, while the remainder had to be imported from the Pearl Harbor District (36.84 mgd) and the Windward District (0.86 mgd). Pumpage from the Pearl Harbor aquifer, however, cannot be further increased without risking serious encroachment of sea water into the basal water lens. (The Board of Land and Natural Resources currently limits the Honolulu District's total allowed draft from the Pearl Harbor aquifer to 40.21 mgd.) (Information provided by R. Doi of the Board of Water Supply, May 20, 1988.)

Demand for water in the Honolulu District is projected to increase by 14 percent between 1987 and 2000 to 92.4 mgd. During this same period, islandwide water demand is projected to rise by 28 percent. To meet growing demand, the Board of Water Supply is seeking to identify, test, and develop new groundwater sources in the Windward District. Kaipapa'u and other proposed Windward Oahu potable water sources are estimated to have a maximum potential yield of about 41 to 45 mgd. Some of this will go toward meeting the projected demand on the windward side, which is estimated to increase from 16.9 mgd (FY 1986-87) to 20.7 mgd in the year 2000. The remainder will be pumped around Makapu'u to Honolulu. If the Kaipapa'u source is determined feasible for development, an estimated 1.5 mgd may be added to the BWS system.



The Board of Water Supply has considered a number of alternatives to potable groundwater sources, such as desalination, development of surface and brackish water sources, and the recycling of treated wastewater. Until these alternatives become acceptable from a technical, health, and/or cost standpoint, BWS will continue its emphasis on the development of groundwater sources.

## CHAPTER 3

### EXISTING CONDITIONS

#### 3.1 PHYSICAL ENVIRONMENT

##### 3.1.1 Geology

Windward Oahu is the remnant of the Ko'olau Volcano. Valleys were carved into the basalt of the Ko'olau Range as eruptions became less frequent. Some of the gravel and clay formed by weathering and erosion of the shield were deposited on valley floors. In addition, alluvium of marine origin accumulated in the valleys as the sea level rose and fell during inter-glacial periods.

The Kaipapa'u area was part of the northeast rift zone of the Ko'olau Volcano, which extended from the main caldera (centered around Kailua and Kaneohe) to Kahuku. A major feature of the Ko'olau Range is an extensive dike complex formed in the rift zone. These intrusive dikes were formed when molten rock flowing through fissures in the volcano cooled and solidified in the fissures. Because the lava solidified while still under pressure, the rock that formed the dikes is much denser and less permeable than the older, surrounding lava flows. Rainfall that is not lost to evapotranspiration or surface runoff infiltrates into the highly porous Ko'olau basalt and is stored as groundwater between the relatively impermeable dikes.

##### 3.1.2 Hydrology

These dike compartments are typically found in higher elevations of the Ko'olau. At a lower elevation, extending 11 miles between Punalu'u and Kahuku, is the Ko'olauloa Basal Aquifer. This substantial body of basal groundwater floats on top of salt water and is confined by either sedimentary caprock or occasional dikes. It is recharged primarily by leakage and overflow of dike-impounded groundwater from higher elevations and, to a lesser extent, by infiltration of rainfall and stream flow. It is expected that the proposed exploratory well at Kaipapa'u will tap a dike basal water source that is part of the Ko'olauloa Basal Aquifer.

Kaipapa'u Stream is located downslope from the proposed access road and well site. It is a small perennial stream that drains from the relatively narrow Kaipapa'u Gulch into the ocean. In the *Windward Oahu Regional Water System Improvements EIS* (Board of Water Supply, 1987), the consultant estimated the base discharge of Windward Oahu streams in 1985, that is, the approximate discharge at elevation of maximum dry-weather discharge. For Kaipapa'u Stream, the estimate was 0.1 to 0.2 mgd.

##### 3.1.3 Topography

The proposed exploratory well is located on a hillside at an elevation of about 145 feet above sea level. Slope at the well site is approximately 30 percent.

##### 3.1.4 Climate

Average monthly temperature in the Kahuku area, about six miles to the northwest of Hau'ula, ranges from approximately 72 degrees F. in the coolest month to 79 degrees F. in the warmest month (State of Hawaii Data Book, 1987). Exposed to the prevailing northeast tradewinds off the ocean, the windward coast experiences very little variation in temperature between day and night. Average annual rainfall at Kaipapa'u is approximately 75 inches, and the winters tend to be wetter than the summers (Atlas of Hawaii, 1973).

### 3.1.5 Soil

Soil in the project area is classified by the U.S. Department of Agriculture Soil Conservation Service (August 1972) as Kawaihapai stony clay loam, 2 to 6 percent slope (KlaB). The Kawaihapai series consists of well-drained soils in drainageways and alluvial fans on the coastal plains of Oahu and Molokai. These soils formed in alluvium derived from basic igneous rock in humid uplands. KlaB soil is characterized by stones which hinder, but do not prevent, cultivation. It has a capability classification of IIe (irrigated or nonirrigated), which means that the soil is subject to moderate erosion if cultivated and not protected.

The proposed exploratory well site and access road corridor are not in agricultural use, and they are not located on agricultural land of importance to the State.

### 3.1.6 Natural Hazards

According to the National Flood Insurance Program Flood Insurance Rate Map, the proposed well site is in Zone D, an area in which flood hazards are undetermined (Federal Emergency Management Agency, 1987). The well site is upslope from Ma'akua Stream, so the risk of flooding appears to be slight.

Earthquake risk in the Kaipapa'u vicinity is minimal. The island of Oahu is classified as a Seismic Zone 1 area, in which damage would be minor in the event of an earthquake (Uniform Building Code, 1979).

### 3.1.7 Flora

On May 10, 1988, a walk-through botanical survey along the access road corridor and well site was conducted by Char & Associates, Botanical/Environmental Consultants. It was found that vegetation in the area is dominated by introduced species, including Christmas berry, guava, and *Psidium littorale*. Grassy areas, covered primarily with broomsedge and a few scattered trees and shrubs, are found on some slopes. The proposed well would be located on a grassy slope which is about 40 to 50 percent bare soil and rock. Small trees of the native 'ohi'a-lehua are found on the site. Also associated with these open, grassy areas are the native 'akia, pukiawe, and 'ulei. Close to the stream are small scattered stands of mango, Java plum, hala, and kukui.

None of the plants inventoried during the survey are rare, threatened, or endangered. Char & Associates concluded that the native plant communities in the area would not be affected by the activities associated with construction of the access road and the exploratory drilling and pump tests.

### 3.1.8 Fauna

**Terrestrial Wildlife.** It is unlikely that the project site provides an important habitat for any endangered native bird species. The botanical survey confirmed that introduced vegetation dominates the Kaipapa'u area, and apart from waterbirds, most endemic birds on the island are limited to native forests. Exceptions include the 'elepaio (*Chasiempis sandwichensis*), which has been found in some areas where nearly all of the vegetation is composed of introduced plants, and the pueo or Hawaiian short-eared owl, which is found in open grassland, pastures, forests, lava flows, and residential areas. It is possible that these birds frequent the Kaipapa'u project area, but the more common species found in a guava mixed forest habitat include the cardinal, barred dove, spotted dove, ricebird, and Japanese white eye (mejiro)—all of which are introduced (*Atlas of Hawaii*, 1973).

**Stream Fauna.** As part of the environmental impact statement prepared for the Windward Oahu Regional Water System Improvements, a biological survey of 32 perennial streams from Waimanalo to Kahuku was conducted in 1983-84 by Kelly M. Archer, Aquatic Biologist (1984).

The purpose of the survey was to determine the diversity and abundance of native stream animals and to rank the streams according to biological quality. Kaipapa'u Stream was included in the survey; a sampling station was located upstream from the proposed well site. The crustacean o'pae kala'ole (*Aryoida bisulcata*) was found to be abundant at the station (5-10 individuals counted). This endemic shrimp is common (2-4 individuals counted) to abundant in perennial Hawaiian streams up to an elevation of about 3,300 feet. O'pae kala'ole is considered to be diadromous, that is, passage to the ocean and back is an essential part to its reproductive process. No other conspicuous macrofauna was observed at the station during the survey.

Based on the survey, as well as previous studies, Archer assigned stream quality ratings to show how the Windward Oahu streams compare with each other. On a scale of High, Moderate, and Low Quality, Kaipapa'u was designated as Low Quality. Streams in this category are represented as having (1) fewer than two established native species found to be "common" or more abundant; (2) significant stream channelization or alteration; (3) few, if any, natural riffle areas with high stream flow velocities; and (4) clear stream water only at base (dry-weather) flow.

### 3.1.9 Archaeology

An archaeological reconnaissance survey of the project area was conducted by Paul H. Rosendahl, Ph.D., Inc. (PHRI) on September 28, 1988. The objectives of the survey were to (a) find and locate all sites present in the vicinity of the well site and access road corridor, (b) evaluate the potential significance of all identified archaeological remains, (c) determine the possible impacts of any proposed development on the remains and (d) define the scope of any subsequent archaeological work that might be necessary or appropriate. Tasks included a literature review, a walk-through survey (100% coverage of the project area), and analysis of background and field data.

Two features were identified, a wall and a ditch. The wall may be part of the same wall identified in an earlier survey; the ditch is newly identified. Both are located on the northwest slope of Kaipapa'u Gulch not far from the trailhead at the end of Kawaipuna Street.

The somewhat L-shaped wall is situated about 80 feet from the foot trail. It is in poor to fair condition and tentatively interpreted to be a prehistoric agricultural boundary wall. Located approximately 85-95 feet from the trail, the ditch is very eroded and in poor to fair condition. It is tentatively interpreted as an 'auwai or agricultural irrigation channel of prehistoric origin.

Both sites are assessed as being of limited to moderate significance in terms of information content, and of limited significance in terms of interpretive and cultural values. In spite of this assessment, PHRI recommends that a program of limited data recovery be conducted in the project area, including test excavations, detailed recording of all features, recovering dating samples, and additional historical documentary research. If this recommendation is not compatible with project plans, PHRI recommends that the two features be preserved "as is" and that limited data recovery work be conducted at a later date. The features could be avoided during construction; it is recommended that they be flagged prior to any work, and that all grubbing or other construction activities in the immediate vicinity be monitored by a qualified archaeologist.

PHRI states that due to the extremely dense vegetation in the area, small inconspicuous features may have been overlooked. Potentially significant, previous unidentified structural remains or subsurface cultural features might be encountered in the course of development activities. In such a situation, it is recommended that archaeological consultation be sought immediately.

### 3.2 SOCIO-ECONOMIC ENVIRONMENT

Hau'ula is a rural beach community situated on Oahu's windward coast, with Punalu'u to the southeast and Laie to the northwest. In 1980, Hau'ula had a population of about 3,000 (Hawaii State Data Book, 1987). It is a residential community composed largely of single-family homes.

Economic activities include small-scale agriculture and retail establishments to serve both local residents and those driving along the scenic coastal road. Hau'ula has a small shopping center, as well as an elementary school, fire station, and a County beach park.

## CHAPTER 4

### SUMMARY OF POTENTIAL IMPACTS AND MITIGATION MEASURES

The impacts associated with construction of the access road and the exploratory drilling and testing will be temporary, lasting no longer than the duration of the project—about six or seven months. No long-term impacts are foreseen.

#### 4.1 TEMPORARY IMPACTS DURING CONSTRUCTION OF THE ACCESS ROAD, DRILLING, AND PUMPAGE TESTS

Construction of the access road and preparation of the well site will require clearing of existing vegetation and grading. Erosion is a potential adverse impact. With the vegetation cover removed, runoff may occur during grading and result in sediment deposit in nearby Kaipapa'u Stream. It is noted that the proposed well site is situated on a partially eroded slope area. This impact can be minimized by having the site revegetated with grass species already in the area as soon as possible.

Noise will not be a problem because of the project's distance from populated areas. There will be some noise from equipment during construction of the access road section at the end of Kawaipuna Street. However, this part of the work, carried out during regular working hours, will quickly progress away from the residential area. Noise generated during the drilling and pump test phases of the project will have no impact at the isolated well site. Other impacts, such as increases in traffic, dust, and emissions from vehicles and equipment, are expected to be insignificant.

#### 4.2 IMPACTS ON STREAM FLOW AND STREAM ENVIRONMENT

Kaipapa'u Stream is fed, in part, by groundwater leaking out of the dike system. To the extent that the pumpage tests lower the groundwater level, they will reduce the hydraulic head and, therefore, the groundwater leakage into the stream. In practice, however, the reduction is likely to be so small as to be undetectable. No significant adverse effect on stream flow or the stream ecosystem is anticipated.

Additional study may be required to ascertain the longer term effects of a production well on stream flow if development of the well is considered feasible.

#### 4.3 IMPACT OF ARCHAEOLOGICAL RESOURCES

The access road alignment runs adjacent to two features identified in an archaeological reconnaissance survey conducted in the project area by Paul H. Rosendahl, Ph.D., Inc. One is a wall which probably served to delineate planting areas; the other is tentatively interpreted as an irrigation ditch. PHRI states that both features could be avoided during construction and recommends that they be flagged prior to any work, and that grubbing or other construction activities in the vicinity be monitored by a qualified archaeologist.

According to PHRI, there is the possibility that previously unidentified significant cultural remains might be encountered in the project area, and that immediate archaeological consultation should be sought in such a situation. The evaluations and recommendations made by the archaeologist have been based on a surface reconnaissance survey, so subsurface cultural remains or deposits might be present. Furthermore, the survey was constrained somewhat by the extremely dense vegetation in the area.

## **CHAPTER 5**

### **POSSIBLE ALTERNATIVES**

#### **5.1 NO ACTION**

The proposed project is part of an overall groundwater development program intended to increase the municipal water supply to meet growing demand. Its immediate objective is to determine the yield and quality of the site as a potential source of potable water to serve the Board of Water Supply's Honolulu and Windward Districts. Under the "no action" alternative, neither of these objectives would be achieved.

#### **5.2 DELAYED PROJECT**

Delay of the project would initially have the same effect as the "no action" alternative. Drilling and testing at a later date may result in higher costs due to inflation.

#### **5.3 ALTERNATE SITES**

The Board of Water Supply has plans to test a number of other potential well sites in the Windward District, so an alternative is to commence with one or more of these sites and delay the Kaipapa'u project. However, Kaipapa'u is a favorable location because of its relatively high expected yield of 1.5 mgd and remoteness from homes and public facilities. Botanical and archaeological surveys indicate there are no significant impediments to the project.

## **CHAPTER 6**

### **DETERMINATION**

In accordance with Chapter 343, Hawaii Revised Statutes, it has been determined that an Environmental Impact Statement is not required for the proposed Kaipapa'u exploratory well and access road. The determination has been made based primarily on the short duration of the project and its minimal impact on the environment. Several potentially negative impacts have been identified, but they would be minimized or alleviated by the suggested mitigation measures..



## CHAPTER 7

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PAUL H. ROSENDAHL, Ph.D., Inc.  
*Consulting Archaeologist*

Report 418-111088(K)

ARCHAEOLOGICAL RECONNAISSANCE SURVEY  
PROPOSED KAIPAPAU EXPLORATORY WELL SITE  
AND ACCESS ROAD PROJECT AREA

Land of Kaipapau  
Koolauloa District, Island of Oahu  
(TMK:5-4-04:Por.3,4,24)

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### SUMMARY

On September 28, 1988, Paul H. Rosendahl, Ph.D., Inc. (PHRI) conducted an archaeological reconnaissance survey at the Proposed Kaipapau Exploratory Well Site and Access Road project area, situated in the Land of Kaipapau, Koolauloa District, Island of Oahu (TMK:5-4-04:Por.3,4,24). The basic objective of the survey was to provide information appropriate to and sufficient for the preparation of an Environmental Impact Assessment (EIA).

During the survey two features were recorded (a wall and a ditch). The wall and ditch appear to constitute features associated with previously identified Upper Kaipapau Stream, Site 50-80-05-1056\* (HRHP 1971). Based on the findings of the present study, the wall is tentatively interpreted as an agricultural boundary wall (possibly delineating planting areas), and the ditch is tentatively interpreted as an agricultural irrigation ditch ('auwai). Both sites are assessed as being of limited to moderate significance in terms of information content, and of limited significance in terms of interpretive and cultural values. For the two sites, further data collection in the form of limited data recovery, including detailed recording and test excavations, is recommended as appropriate.

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\*State Inventory of Historic Places (SIHP) site designation system: all four-digit site numbers prefixed by 50-80-05- (50 = State of Hawaii, 80 = Island of Oahu, 05 = USGS 7.5' series quad map ["Hauula, Oahu"]). SIHP sites include Hawaii Register of Historic Places (HRHP) sites. In 1981, at the recommendation of the State Attorney General, all sites both on state land and on private property, for technical and procedural reasons, were removed from the HRHP register and, retaining their numerical designations, were placed onto the SIHP register. Subsequently, SIHP sites cleared technically and procedurally were placed back onto the HRHP register.

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## INTRODUCTION

### BACKGROUND

At the request of Ms. Susan Rutka of Belt, Collins & Associates, for their client, Board of Water Supply - City and County of Honolulu, Paul H. Rosendahl, Ph.D., Inc. (PHRI) conducted a surface reconnaissance survey (100%) of the Proposed Kaipapau Exploratory Well Site and Access Road project area, situated in the Land of Kaipapau, Koolauloa District, Island of Oahu (TMK:5-4-04:Por.3,4,24). The basic objective of the survey was to provide information appropriate to and sufficient for the preparation of an Environmental Impact Assessment (EIA).

Field work for the survey was conducted on September 28, 1988 under the supervision of PHRI Supervisory Archaeologist Alan T. Walker, and under the overall direction of PHRI Principal Archaeologist Dr. Paul H. Rosendahl. Approximately 30 man-hours of labor were expended conducting the field work.

An oral preliminary report outlining the field work findings, tentative evaluations, preliminary conclusions, and recommendations was made to Ms. Rutka in October 1988. The present report constitutes the final report of the current project.

### SCOPE OF WORK

The basic purpose of an archaeological reconnaissance survey (also called an archaeological inventory survey) is to identify--to discover and locate on available maps--sites or features of possible archaeological significance. A reconnaissance survey is simply a pedestrian, or walk-through survey--extensive rather than intensive in scope--conducted to determine the presence or absence of archaeological resources within a specified project area. A reconnaissance survey indicates both the general nature and variety of archaeological remains present, and the general distribution and density of such remains. A reconnaissance survey permits a preliminary evaluation of the archaeological resources, and facilitates formulation of realistic recommendations and estimates for such further archaeological work as might be necessary or appropriate. Such further work could include intensive survey--detailed recording of sites and features, and selected test excavations; and possibly subsequent mitigation--data recovery excavations, interpretive planning and development, and/or preservation of sites and features with significant scientific research, interpretive, and/or cultural values.

The principal objectives of the current reconnaissance survey were four-fold: (a) to identify (find and locate) all sites present within the project area, including previously recorded and newly identified sites; (b) to evaluate the potential significance of all identified

archaeological remains; (c) to determine the possible impacts of any proposed development upon the identified remains; and (d) to define the scope of any subsequent archaeological work that might be necessary or appropriate.

Based on a review of available background literature and on discussions with Dr. Joyce Bath, staff archaeologist for Oahu in the Hawaii State Department of Land and Natural Resources - Historic Sites Section (DLNR-HSS), the following specific tasks were determined to constitute an adequate and appropriate scope of work for the surface reconnaissance survey:

1. Review available archaeological and historical literature relevant to the immediate project area;
2. Conduct 100% coverage surface reconnaissance of the entire project area, with emphasis on (a) relocation and evaluation of all previously recorded sites, and (b) identification, recording, and evaluation of any previously unidentified sites; and
3. Analyze background and field data, and prepare appropriate reports.

The reconnaissance survey was carried out in accordance with the standards for reconnaissance-level survey recommended by the Society for Hawaiian Archaeology (SHA). These standards are currently used by the DLNR-HSS as guidelines for reviewing and evaluating archaeological reconnaissance survey reports submitted in conjunction with various development permit applications.

#### PROJECT AREA DESCRIPTION

The Proposed Kaipapau Exploratory Well Site and Access Road project area is situated in Kaipapau Gulch, partially within the bounds of previously designated HRHP Site 50-80-05-1056, Upper Kaipapau Stream (HRHP 1971) (Figure 1). Kaipapau Stream meanders along the southeast side of the project area, southeast of a 2,800-ft-long narrow trail which winds through thick vegetation. The project area includes portions of Land Court Application Parcels 999 and 1266. No Land Commission Awards (LCAs) are present within the project area.

According to a letter from Ms. Susan Rutka of Belt, Collins & Associates to Dr. Paul H. Rosendahl of PHRI (dated February 3, 1988), the well site portion of the project area consists of approximately 30,000 sq ft, and the access road portion is approximately 1,500 ft long. However, a blue-line topographic map (1"=200' scale, 5-ft contours, Sheet No. 528-162) prepared by R.M. Towill Corporation and provided to PHRI by Belt, Collins & Associates indicates the access road is 2,800 ft long.

418-111088(K)

3

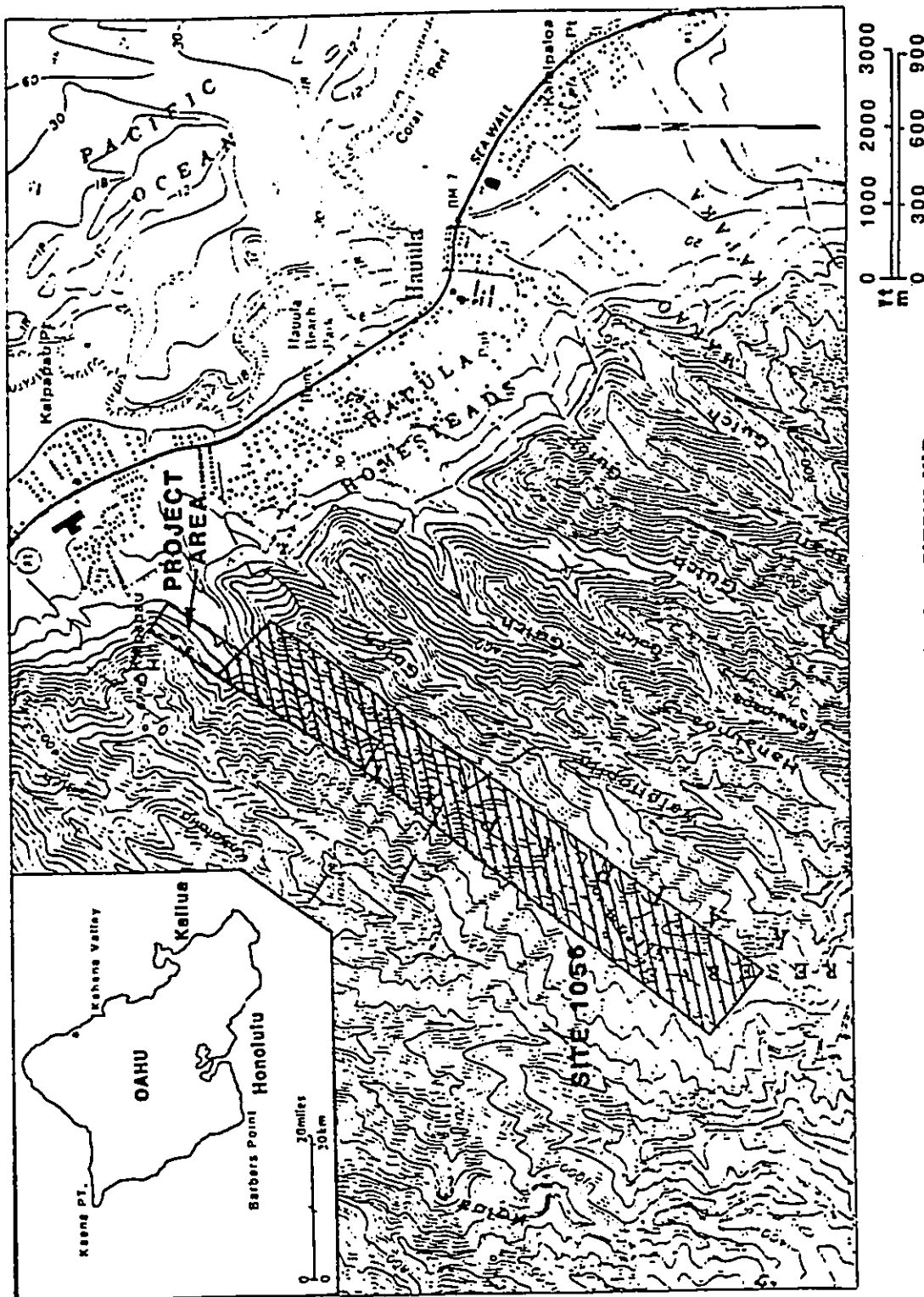


Figure 1. PROJECT AREA LOCATION MAP

ARCHAEOLOGICAL RECONNAISSANCE SURVEY  
PROPOSED KAIPAPAU EXPLORATORY WELL SITE  
AND ACCESS ROAD PROJECT AREA

Land of Kaipapau, Koolauloa District  
Island of Oahu (TMK:5-4-04:Por.3,4,24)

PHRI Project 88-418

November 1988

Furthermore, during the field work the flag indicating the location of the proposed well site (the flag as indicated by L. Whang of the Board of Water Supply) was situated 900 ft inland of where it is depicted on the blue-line map, making the proposed access road approximately 3,700 ft long. (As a precautionary measure, the present survey included the entire 3,700 ft long access road.)

Vegetation within the project area consists primarily of an extremely dense overstory of Christmas-berry (Schinus terebinthifolius Raddi) and guava (Psidium guajava L.) and scattered specimens of hau (Hibiscus tiliaceus L.), Java Plum (Eugenia cuminii [L.] Druce.), and mango (Mangifera indica L.). The understory, also extremely dense, consists primarily of lau'a'e (Microsorium scolopendria [Burm.] Copel.), ki (Cordyline terminalis [L.] Kunth), noni (Morinda citrifolia L.), and various grasses.

Soil in the project area generally consists of Kawaihapai stony clay loam (2-6% slopes), representing the Kawaihapai series of well-drained soils present in drainages and on coastal plain alluvial fans on Oahu and Molokai (Foote et al. 1972). The terrain of the project area rises in elevation from c. 60 ft AMSL (above mean sea level) along its northeast end to approximately 250 ft AMSL along its southwest end. Rainfall in the general vicinity of the project area is 75-100 inches per year, and the mean annual temperature in the project area is approximately 70-80 degrees Fahrenheit (Armstrong 1983:62,64).

#### PREVIOUS ARCHAEOLOGICAL WORK

Prior to the present project, there have been only two archaeological studies conducted within the present project area. One study was conducted as part of the Statewide (Hawaii) Inventory of Historic Places (HRHP 1971), and the other study consisted of a survey by Chiniago Inc. (Barrera 1984).

The Statewide Inventory of Historic Places study (HRHP 1971) identified Site 1056, Upper Kaipapau Stream (records on Site 1056 are available at the DLNR-HSS). According to the HRHP nomination form, Upper Kaipapau Stream includes a large wall, a platform containing a "wahine slit" rock, and other structures that due to the thick vegetation could not be located (the unlocated sites had been reported by local farmers). Because there was a high potential for other archaeological features being present at the site, the inventory study recommended that Site 1056 be surveyed thoroughly prior to any development.

The survey by Chiniago Inc. in late 1983 and early 1984 was conducted by Barrera (1984) at the request of VTN Pacific. The survey included documentary research and an off-site inspection. The project area was inspected from atop a ridge outside the project area because permission to conduct an on-site inspection had not been granted (Barrera 1984).



Barrera's documentary research included reviewing work by McAllister (1933), Handy (1940), the Statewide Inventory Survey (HRHP 1971), and State Survey Office maps. Informant information obtained from Handy (1940:91) indicated taro flats were once present along Kaipapau Stream and that the land below the gulch was terraced (probably for agriculture) prior to sugarcane cultivation. It was not indicated if the taro flats contained any structural modifications. In concluding his study, Barrera recommended an on-site reconnaissance survey of the project area be conducted (1984).

#### FIELD METHODS AND PROCEDURES

Field work was conducted on September 28, 1988 by PHRI Supervisory Archaeologists Alan T. Walker and Bert Rader, assisted by PHRI Field Archaeologist Jack Harris. The survey was accomplished by means of a series of pedestrian transects oriented both parallel and perpendicular to the major axis of the Access Road. The parallel transects consisted of walking along the 2,800-ft-long narrow foot trail traversing the southeast side of the project area and examining the area immediately adjacent to the trail. The perpendicular transects were conducted over the area extending 30 m northwest of the trail and over the area of the proposed well sites. The perpendicular transects overall progressed in a southwesterly to northeasterly direction. During the perpendicular transects, intervals between sweeping crew members were 15.0-20.0 m.

As archaeological features were identified, they were flagged with orange-and-blue flagging tape and were assigned a PHRI temporary sequential number prefixed by "418-", beginning with 418-1. All features were plotted on a blue-line topographic map (1"=200' scale, 5 ft contours, Sheet No. 528-162) prepared by R.M. Towill Corporation and provided by Belt, Collins & Associates. Feature plotting was aided by an approximate 1"=200' scale black-and-white aerial photo (R.M. Towill Corp., 1988: Photo No. 8527-27).

Identified features were recorded on standard PHRI site and feature record forms. A complete 35 mm black-and-white photographic record of the field work was kept (PHRI Roll No. 875). Sites were tagged with an aluminum marker bearing the site number, PHRI project number (88-418), and the date. The same information as on the aluminum marker was written on lengths of flagging tape, which were then wrapped around stones and placed in protected places on the site.

## FINDINGS

During the present survey two features were identified--a wall and a ditch. The wall (Feature 418-1) may be part of the same wall identified during the Statewide Inventory of Historic Places (1971). The ditch (Feature 418-2) is newly identified. The wall and ditch are summarized in Table 1 and their locations are indicated on Figure 2. The platform identified during the statewide survey was not relocated as an accurate location map for the feature was not available. Due to the extremely dense vegetation in the project area, small inconspicuous features in the area may have been overlooked. No indigenous or early historic portable remains were observed in the project area.

## FEATURE 418-1 - WALL

Feature 418-1 is a somewhat L-shaped wall situated on the northwest slope of Kaipapau Gulch, about 25.0 m from the foot trail mentioned earlier. The wall is in poor to fair condition and appears to be an original, unmodified construction. The wall measures c. 15.0 m long (measured from tip to tip of L-shape) by 0.50-0.75 m wide by 1.0 m high. It consists of subangular basalt boulders crudely stacked three to four courses high. The wall is free-standing and is crudely faced on both sides. Several soil pockets are present in the vicinity of the wall. Because the wall may have served to delineate these pockets, the wall is tentatively assigned an agricultural function. The structural form of the feature and its location and condition indicate it is prehistoric.

## FEATURE 418-2 - DITCH

Feature 418-2 is situated on the northwest slope of Kaipapau Gulch about 25.0-30.0 m from the afore-mentioned foot trail. The ditch is very eroded and is in poor to fair condition, and it appears to be unmodified. The ditch measures c. 30.0+ m long by 1.75 m wide by 0.40 m deep. It is constructed perpendicular to the slope of the mountain. The upslope side of the ditch is cut slightly into the soil and the downslope side consists of a rounded soil embankment. The ditch in cross-section profile appears as a shallow U-shape. The ditch is not boulder-faced, and it does not contain kerbstones; it is tentatively interpreted to function as an 'auwai or agricultural irrigation channel. The structural form of the feature and its location and condition indicate it may be prehistoric.

Table 1.

SUMMARY OF IDENTIFIED FEATURES  
PROPOSED KAIPAPAU EXPLORATORY WELL SITE  
AND ACCESS ROAD PROJECT AREA

Site/Fea. Number	Formal Site/Feature Type	Tentative Functional Interpretation	*CRM Value Mode Assess.			#Field Work Tasks		
			R	I	C	DR	SC	EX
418-1	Wall	Agriculture	M	L	L	+	-	+
418-2	Ditch	Agriculture	M	L	L	+	-	+

\*Cultural Resource Management Nature: R = scientific research,  
Value Mode Assessment: I = interpretive, C = cultural;  
Degree: H = high, M = moderate, L = low

#Field Work Tasks: DR = detailed recording (scaled drawings, photo-  
graphs, and written descriptions), SC = surface collections, EX = test  
excavations

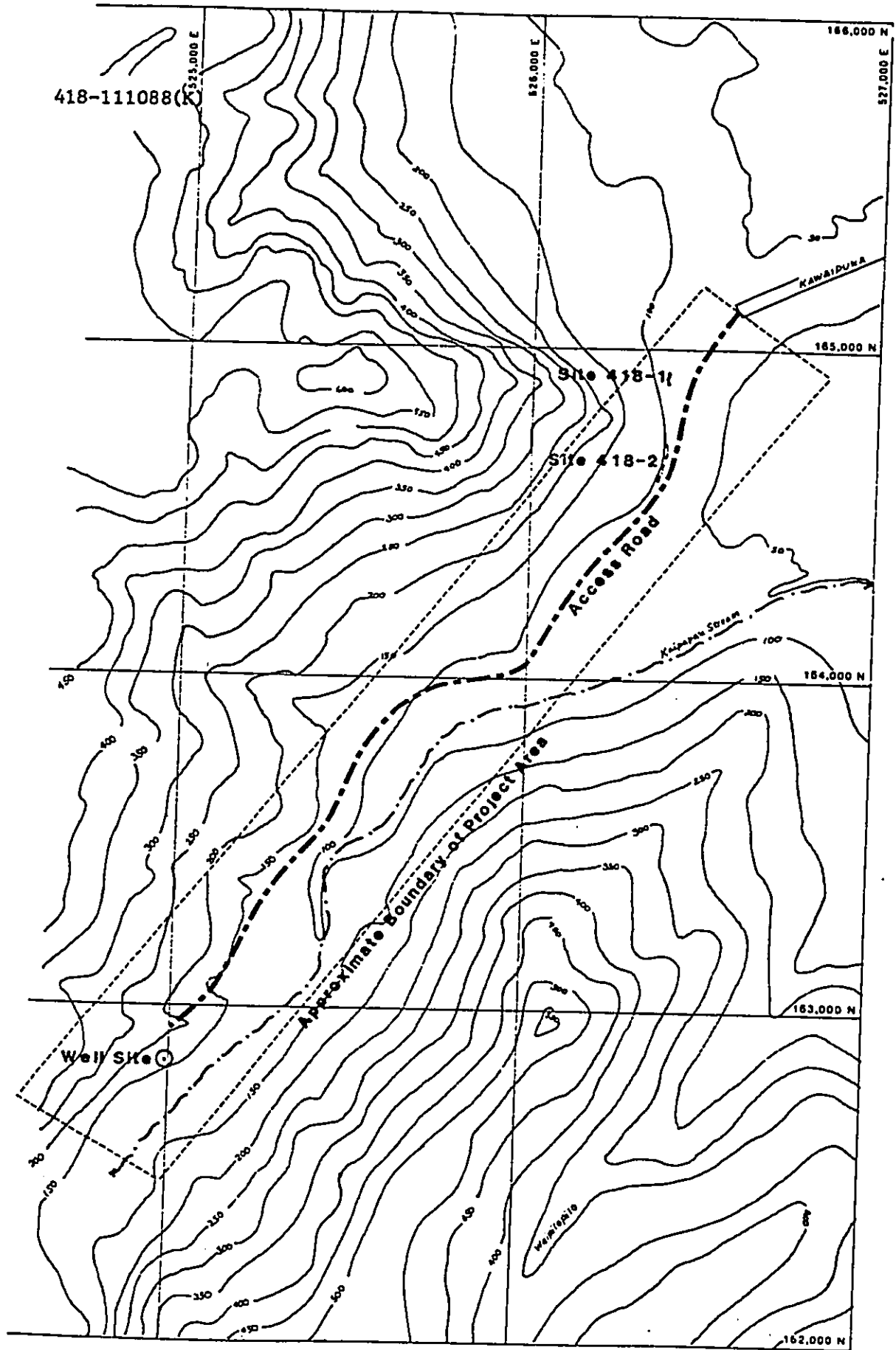


Figure 2. SITE LOCATION MAP

## CONCLUSION

### DISCUSSION

The data collected during the present investigation indicates that Features 418-1 and -2, even though the features are outside the formal bounds of the site, are associated with previously identified Site 1056, Upper Kaipapau Stream. The features, a ditch and a wall, are tentatively interpreted as a prehistoric 'auwai and a prehistoric agricultural wall, respectively. The ditch and the wall may indicate that both dryland and wetland (irrigated) agricultural strategies were employed within Kaipapau Gulch.

The present project area is on the windward coast of Oahu, where there are numerous permanently flowing streams, large tracts of fertile land, colluvial soils, river valleys suited for cultivating Polynesian crops, and offshore, a variety of marine life. Such an environment was attractive and ecologically optimal for early Polynesian settlers (Kirch 1985). Early coastal settlements on windward Oahu in the general vicinity of the present project area include Kahana Valley (Hommon and Barrera 1971; Hommon and Bevacqua 1973) and Malaekahana Bay (Yent and Estioko-Griffin 1980). The major subsistence activity conducted by inhabitants of these coastal settlements was marine exploitation. The marine exploitation was probably complemented by agricultural exploitation of the inland zone. At Kahana Valley, inland agricultural sites occur in conjunction with coastal settlements (Hommon and Barrera 1971; Hommon and Bevacqua 1973). Likewise, Features 418-1 and -2 within Kaipapau Gulch are probably associated with coastal settlement at Hauula.

As mentioned earlier, the present survey was hampered somewhat by the extremely dense vegetation in the project area. While two features associated with Site 1056 were identified/reidentified, a terrace identified by the previous statewide inventory (HRHP 1971) and other stone structures reported by local farmers could not be relocated. The unrellocated sites are either hidden by dense vegetation, or they are located farther up Kaipapau Gulch, outside the present project area.

### GENERAL SIGNIFICANCE ASSESSMENTS AND RECOMMENDED GENERAL TREATMENTS

To facilitate State and County review, general significance assessments and recommended general treatments for sites/features in the project area are summarized in Table 2. Significance categories used in the site evaluation process are based on the National Register criteria for evaluation, outlined in the Code of Federal Regulations (36 CFR Part 60). The Hawaii State Historic Preservation Office (SHPO) uses these criteria for evaluating cultural resources. Sites/features determined to be potentially significant for information content (Category A, Table 2) fall under Criterion D, which defines significant resources as ones which

Table 2.

**SUMMARY OF GENERAL SIGNIFICANCE ASSESSMENTS  
AND RECOMMENDED GENERAL TREATMENTS  
PROPOSED KAIPAPAU EXPLORATORY WELL SITE AND ASSESS ROAD**

Site 1056 Feature No.	Significance Category				Recommended Treatment			
	A	X	B	C	FDC	NFW	PID	PAI
418-1	+	-	-	-	+	-	-	-
418-2	+	-	-	-	+	-	-	-

**General Significance Categories:**

A=Important for information content, further data collection necessary (PHRI=research value);

X=Important for information content, no further data collection necessary (PHRI=research value, SHPO=not significant);

B=Excellent example of site type at local, region, island, State, or National level (PHRI=interpretive value); and

C=Culturally significant (PHRI=cultural value).

**Recommended General Treatments:**

FDC=Further data collection necessary (intensive survey and testing, and possibly subsequent data recovery/mitigation excavations);

NFW=No further work of any kind necessary, sufficient data collected, archaeological clearance recommended, no preservation potential (possible inclusion into landscaping suggested for consideration);

PID=Preservation with some level of interpretive development recommended (including appropriate related data recovery work); and

PAI=Preservation "as is," with no further work (and possible inclusion into landscaping), or minimal further data collection necessary.

"have yielded, or may be likely to yield, information important in prehistory or history" (36 CFR Sec. 60.4). Sites/features potentially significant as representative examples of site types (Category B) are evaluated under Criterion C, which defines significant resources as those which "embody the distinctive characteristics of a type, period, or method of construction...or that represent a significant and distinguishable entity whose components may lack individual distinction" (36 CFR Sec. 60.4).

Sites/features with potential cultural significance (Category C) are evaluated under guidelines prepared by the Advisory Council on Historic Preservation (ACHP) entitled "Guidelines for Consideration of Traditional Cultural Values in Historic Preservation Review" (Draft Report, August 1985). The guidelines define cultural value as "...the contribution made

by an historic property to an ongoing society or cultural system. A traditional cultural value is a cultural value that has historical depth" (1981:1). The guidelines further specify that "[a] property need not have been in consistent use since antiquity by a cultural system in order to have traditional cultural value" (1985:7).

In order to facilitate future client management decisions regarding site/feature treatments, sites/features are further evaluated in terms of three value modes, which are derived from the above state and federal evaluation criteria. Archaeological sites/features are evaluated in terms of potential scientific research, interpretive, and/or cultural values (Table 1). Research value refers to the potential of archaeological resources to produce information useful in the understanding of culture history, past lifeways, and cultural processes at the local, regional, and interregional levels of organization. Interpretive value refers to the potential of archaeological resources for public education and recreation. Cultural value refers to the potential of archaeological resources to preserve and promote cultural and ethnic identity and values. Significant assessments for each feature, in terms of nature and degree of these three value modes, and specific data collection field work tasks for each feature are included in Table 1.

Based on the above state and federal criteria, the following recommendations are made. Although Features 418-1 and -2 are not good examples of site/feature types and are of limited cultural value, they still contain potentially significant information content--specifically, the features have not yet been dated, and dating may provide valuable information on the nature and function of inland agricultural features associated with coastal settlements. Therefore, it is recommended that a program of limited data recovery be conducted in the project area. This program would include test excavations and detailed recording of all features, and would focus on recovering dating samples. It is also recommended that additional historical documentary research on the project area be conducted.

If the above recommendations are not compatible with development plans, it is recommended that Features 418-1 and -2 be preserved "as is" and limited data recovery work at the features be conducted at a later date. The features are situated on a slope of Kaipapau Gulch and could be avoided during development work. In the event it is decided that the latter course of action will be implemented, it is recommended that the features be flagged prior to any development work, and that all grubbing or other development work in the immediate vicinity of the features be monitored by a qualified archaeologist.

The evaluations and recommendations presented within this final report have been based on a surface reconnaissance survey of the project area. The survey was constrained somewhat by the project area's extremely dense vegetation. Therefore, the possibility exists that potentially significant, previously unidentified structural remains, subsurface cultural features, or deposits might be encountered in the course of future archaeological investigations or subsequent development activities. In such situations, archaeological consultation should be sought immediately.

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BOTANICAL SURVEY  
PROPOSED KAIPAPA'U WELL SITE AND ACCESS ROAD  
KO'OLAULOA DISTRICT, ISLAND OF O'AHU

by

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Prepared for: BELT COLLINS & ASSOCIATES  
May 1988

BOTANICAL SURVEY  
PROPOSED KAIPAPA'U WELL SITE AND ACCESS ROAD  
KO'OLAULOA DISTRICT, ISLAND OF O'AHU

INTRODUCTION

The Board of Water Supply proposes to construct an exploratory well on the north slopes of Kaipapa'u Gulch. The well site will cover an area of about 30,000 square feet (200 ft. X 150 ft.). An access road, approximately 3,000 ft. long by 12 ft. wide, to service the well site is also proposed.

Field studies to gather data on the botanical resources found along the access road corridor and well site were conducted on 10 May 1988. The primary objectives of the studies were to 1) provide a general description of the vegetation; 2) inventory the species; and 3) search for threatened and endangered species in the areas which would be affected by construction activities.

DESCRIPTION OF THE VEGETATION

An overgrown trail meanders to about two-thirds of the way to the proposed exploratory well site. The trail ends abruptly in a dense tangle of Christmas berry shrubs (Schinus terebinthifolius). From here, one reaches the well site by dropping into the Kaipapa'u Stream, which flows actively all year round, and continuing upstream. The well site is situated on the side of a grassy knoll on the rather steep north slopes of Kaipapa'u Gulch.

The proposed access road will generally follow along the over-

grown trail but, instead of dropping closer to the stream where the Christmas berry thicket is densest, it will continue through the dense scrub along the slope and on to the well site.

Vegetation along the trail is a mixture of Christmas berry, guava (Psidium guajava), and Psidium littorale shrubs. In places where the scrub cover is open, elephant grass (Pennisetum purpureum) and California grass (Brachiaria mutica) covers the trail with thick growth. In general though, grasses and herbs are not abundant in the dense scrub cover due to the heavy shade. For example, under the Christmas berry scrub, bare soil and litter predominate. Shade tolerant species such as laua'e (Phymatosorus scolopendria), basket grass (Oplismenus hirtellus), wood fern (Christella parasitica), and blechnum (Blechnum occidentale), may form only 3 to 5% ground cover.

Close to the stream trees of mango (Mangifera indica), Java plum (Syzygium cumini), hala (Pandanus tectorius), and kukui (Aleurites moluccana) form small, scattered stands.

Grassy knolls with scattered shrubs and trees are found along the gulch slopes. These areas are characterized by a rather dense cover of broomsedge grass (Andropogon virginicus). Other species commonly associated with this vegetation type are molasses grass (Melinis minutiflora), sword fern (Nephrolepis multiflora), two species of Pityrogramma fern, pala'a fern (Odontosoria chinensis), pamakani (Ageratina riparia), golden beard grass (Chrysopogon aciculatus), and Spathoglottis plicata. The well site occurs on a grassy slope although bare soil and rock may make up 40 to 50% of the site. Small trees of the native 'ohi'a-lehua (Metrosideros polymorpha), 2 to 3.5 ft. tall, are found on the site. Other native plants found in the area include pukiawe (Styphelia tameiameia), 'akia (Wikstroemia oahuensis), and 'ulei (Osteomeles anthyllidifolia). A few trees of the introduced iron wood (Casuarina equisetifolia) are found on the peripheries of

of the proposed well site.

A checklist of all those vascular plant species inventoried during the field studies is presented at the end of this report. None of the species encountered are considered officially listed, proposed or candidate threatened and endangered species by the federal and/or state governments (U. S. Fish and Wildlife Service 1985; Herbst 1987); nor are any of the species considered rare (Fosberg and Herbst 1975).

#### DISCUSSION AND RECOMMENDATIONS

Vegetation in the lower and middle Kaipapa'u Gulch areas is dominated by introduced species. Christmas berry scrub and smaller amounts of a mixed scrub association (Christmas berry-guava-Psidium littorale) are the most common vegetation types. Grassy areas, covered primarily with broomsedge and a few scattered trees and shrubs, are found on some slopes. A few native plants such as 'ohi'a-lehua, 'akia, 'ulei, etc., are associated with these open, grassy areas.

The vegetation types which occur in Kaipapa'u Gulch are found throughout the many gulch systems behind Hau'ula. None of the plants inventoried during the survey are rare, threatened or endangered. Nor are there any native plant communities in the area which would be affected by the construction activities associated with the development of the well site and access road.

There is little of botanical interest on the well site and access road corridor. Of some concern, however, is the loss of soil and possible sediment deposit into the nearby Kaipapa'u Stream from the well site once the vegetation cover is removed during construction activities. The proposed well site is situated on a partially eroded slope area. It is recommended that the site be revegetated with grass species already in the area as soon as possible.

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PLANT SPECIES CHECKLIST  
PROPOSED KAIPAPA'U WELL SITE AND ACCESS ROAD  
KO'OLAULOA DISTRICT, ISLAND OF O'AHU

In the following species checklist, the plants are divided into four groups: Pteridophytes, Gymnosperms, Monocots, and Dicots. Taxonomy and nomenclature of the Pteridophytes (ferns and fern allies) follow Wagner and Wagner (1987); the Gymnosperms (conifers) and flowering plants (Monocots and Dicots) follow Wagner et al. (in prep.). Common English names are in accordance with St. John, in most cases; Hawaiian names follow Porter (1972) or St. John (1973).

The checklist provides the following information:

1. Scientific name with author citation.
2. Common English or Hawaiian name, when known.
3. Biogeographic status of each species. The following symbols are used:
  - E = endemic = native only to the Hawaiian Islands
  - I = indigenous = native to the islands and to one or more other geographic area(s)
  - P = Polynesian = plants of Polynesian introduction prior to Western contact (1778); not native
  - X = introduced or exotic = brought here by humans after Western contact either deliberately or accidentally; not native.

SCIENTIFIC NAME	COMMON NAME	STATUS
CONIFERS		
Araucariaceae		
<u>Araucaria columnaris</u> (Forst. f.) Hook.	Cook pine	X
FLOWERING PLANTS		
MONOCOTS		
Araceae		
<u>Colocasia esculenta</u> (L.) Schott	taro	P
Commelinaceae		
<u>Commelina diffusa</u> L.	commelina	X
Cyperaceae		
<u>Kyllinga brevifolia</u> Rottb.	kyllinga	X
<u>Rhynchospora</u> sp.?	kuolohia	E
Gramineae		
<u>Andropogon virginicus</u> L.	broomsedge	X
<u>Brachiaria mutica</u> (Forsk.) Stapf	California grass	X
<u>Chrysopogon aciculatus</u> (Retz.) Trin.	golden beard grass	X
<u>Cynodon dactylon</u> (L.) Pers.	Bermuda grass	X
<u>Digitaria ciliaris</u> (Retz.) Koel.	crab grass	X
<u>Digitaria insularis</u> (L.) Mez ex Ekman	sour grass	X
<u>Eleusine indica</u> (L.) Gaertn.	goose grass	X
<u>Melinis minutiflora</u> Beauv.	molasses grass	X
<u>Oplismenus hirtellus</u> (L.) Beauv.	basket grass	X

SCIENTIFIC NAME

COMMON NAME

STATUS

Panicum maximum Jacq.  
Paspalum conjugatum Berg.  
Paspalum fimbriatum HBK.  
Paspalum scrobiculatum L.  
Pennisetum purpureum Schumacher.  
Rhynchelytrum repens (Willd.) C. E. Hubb.  
Sacciolepis indica (L.) Chase  
Setaria gracilis Kunth. in Humb. & Bonpl.

Liliaceae s.l.

Cordyline terminalis (L.) Kunth.

∞

Orchidaceae

Arundina graminifolia (D. Don) Hochr.

Spathoglottis plicata Bl.

Pandanaceae

Pandanus tectorius Parkinson ex Z

Palmae

Pritchardia cf. martii (Gaud.) H. Wendl.

DICOTS

Acanthaceae

Thunbergia fragrans Roxb.

Guinea grass X  
Hilo grass X  
Colombia grass X  
rice grass X  
elephant grass X  
Natal redtop X  
Glenwood grass X  
foxtail X

ti P

bamboo orchid X  
Philippine ground orchid X

hala I?

loulu E

thunbergia X



# SCIENTIFIC NAME

## COMMON NAME

## STATUS

### Anacardiaceae

Mangifera indica L.

Schinus terebinthifolius Raddi

X

### Araliaceae

Schefflera actinophylla (Endl.) Harms

X

### Casuarinaceae

Casuarina equisetifolia Stickm.

X

### Compositae

Ageratina riparia (Rege.) King & Robinson

Bidens alba (L.) DC

X

Calypocarpus vialis Less.

Conyza bonariensis (L.) Cronq.

Conyza canadensis (L.) Cronq.

Emilia fosbergii D. H. Nicolson

Emilia sonchifolia (L.) DC.

Pluchea symphytifolia (Miller) Gillis

Sonchus oleraceus L.

Vernonia cinerea (L.) Less

X

X

X

X

X

X

X

X

X

X

### Convolvulaceae

Ipomoea indica (J. Burm.) Merr.

koali awahi'a

I

SCIENTIFIC NAME	COMMON NAME	STATUS
<b>Cucurbitaceae</b>		
<u>Momordica charantia</u> L.	bittermelon	X
<b>Epacridaceae</b>		
<u>Styphelia tameiameia</u> (Cham.) F. von Muell.	pukiawe	I
<b>Euphorbiaceae</b>		
<u>Aleurites moluccana</u> (L.) Willd.	kukui	P
<u>Chamaesyce multiformis</u> (H. & A.) Croizat & Degener	'akoko	E
<u>Euphorbia heterophylla</u> L.	euphorbia	X
<u>Phyllanthus debilis</u> Klein ex Willd.	phyllanthus	X
<b>Leguminosae</b>		
<u>Chamaecrista nictitans</u> (L.) Moench.	partridge pea, lau-ki	X
<u>Crotalaria pallida</u> Ait.	rattlepod	X
<u>Desmanthus virgatus</u> (L.) Willd.	virgate mimosa	X
<u>Desmodium incanum</u> DC.	beggar's ticks	X
<u>Desmodium triflorum</u> (L.) DC.	beggarweed	X
<u>Indigofera suffruticosa</u> Mill.	indigo	X
<u>Leucaena leucocephala</u> (Lam.) de Wit	koa-hao le	X
<u>Mimosa pudica</u> L.	sleepinggrass	X
<u>Mucuna gigantea</u> (Willd.) DC.	ka'e'e	I?
<b>Lythraceae</b>		
<u>Cuphea carthagenensis</u> (Jacq.) Macbr.	tarweed	X

SCIENTIFIC NAME	COMMON NAME	STATUS
Malvaceae		
<u>Hibiscus tiliaceus</u> L.	hau	I?
<u>Malvastrum coromandelianum</u> (L.) Garcke	malvastrum	X
<u>Sida rhombifolia</u> L.	sida	X
Melastomataceae		
<u>Clidemia hirta</u> (L.) D. Don	Koster's curse	X
Menispermaceae		
<u>Cocculus trilobus</u> (Thunb.) DC.	huehue	I
Myrtaceae		
<u>Metrosideros polymorpha</u> Gaud.	'ohi'a-lehua	I
<u>Psidium guajava</u> L.	guava	X
<u>Psidium littorale</u> Raddi	psidium	X
<u>Syzygium cumini</u> (L.) Skeels	Javaplum	X
Oxalidaceae		
<u>Oxalis corymbosa</u> DC	pink wood-sorrel	X
<u>Oxalis corniculata</u> L.	yellow wood-sorrel	X
Passifloraceae		
<u>Passiflora laurifolia</u> L.	yellow water lemon	X
<u>Passiflora suberosa</u> L.	passiflora	X

SCIENTIFIC NAME	COMMON NAME	STATUS
Plantaginaceae		
<u>Plantago major</u> L.	plantain	X
Rosaceae		
<u>Osteomeles anthyllidifolia</u> Lindl.	u'u lei	E
Rubiaceae		
<u>Canthium odoratum</u> (Forst. f.) Seem.	alahe'e	I
<u>Morinda citrifolia</u> L.	noni	P
Umbelliferae		
<u>Centella asiatica</u> (L.) Urban	asiatic pennywort	X
Verbenaceae		
<u>Lantana camara</u> L.	lantana	X
<u>Stachytarpheta dichotoma</u> (Ruiz & Pavon) Vahl	stachytarpheta	X
<u>Stachytarpheta jamaicensis</u> (L.) Vahl	stachytarpheta	X
<u>Stachytarpheta urticifolia</u> (Salisb.) Sims	stachytarpheta	X
<u>Verbena litoralis</u> HBK.	vervain	X